INDOOR AIR QUALITY ASSESSMENT

Old Hammondtown Elementary School
20 Shaw Street
Mattapoisett, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

At the request of William R. Cooper, Superintendent, Old Rochester Regional School District, the Bureau of Environmental Health Assessment (BEHA) of the Massachusetts Department of Public Health (MDPH) provided assistance and consultation regarding possible mold growth in building components moistened from excessive humidity during August 2003 at the Old Hammondtown Elementary School (OHES), 20 Shaw Street, Mattapoisett, Massachusetts. At the time of the assessment, the building was unoccupied.

On August 22, 2003, a visit to conduct an indoor air quality assessment was made to this school by Michael Feeney, Director of the Emergency Response/Indoor Air Quality (ER/IAQ) program, BEHA.

The OHES is a one story, multi-wing structure constructed in 1966. The school was renovated in 2002. Prior to the BEHA assessment, the school department hired a consultant, Engineering & Fire Investigation (EFI), to characterize water damage and the extent of mold growth within this OHES.

Methods

Visual observation of building components for mold and water damage was conducted. Surface temperature of building and heating, ventilating and air-conditioning (HVAC) system components was measured with a Thermotrace Infrared thermometer, Model No. 15005. Air tests for temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551. Test results are shown in Table 1.

Results/Discussion

The building was evaluated on a warm day, with an outdoor temperature of 83°F and relative humidity of 60 percent. The last recorded rainfall in the OHES area occurred August 17, 2003 (Weather Underground, 2003), five days prior to this assessment. Condensation droplets were noted on unit ventilator (univent) cabinets (Picture 1), chilled water pipe hangers (Picture 2), pipe insulation and other building components. It appeared that the HVAC chilling system had its temperature setting lowered in an effort to reduce water vapor concentrations in the building. Surface temperature of univent coils ranged between 32° F to 64 ° F (Table 1).

There appear to be several sources of moisture generating condensation. The primary source appeared to be introduction of moisture into the building through the univents. When warm, moist air passes over a surface that is colder than the air, water condensation can collect on the cold surface. Over time, water droplets can form, which can then drip from a suspended surface. For this reason, HVAC systems are equipped with drainage systems beneath cooling coils to drain condensate as moist outdoor air is cooled. Univents have light plastic drip pans. When overfilled with water, these drain pans will tend to distort shape, creating a bowl effect, thus preventing drainage and resulting in a pooling effect. Condensation drains in some univents were spot checked and found to be overfilled, which prevent water from reaching the holes that lead to PVC pipe that directs water outside the building. Water flow from the PVC pipe drains was found to be draining minimally (Picture 3) or not at all (Picture 4). As univent air flows over this pooled water in the condensation pans, moisture is reintroduced into each classroom without lower relative humidity.

Condensation is the collection of moisture on a surface at or below the dew point. The dew point is the temperature that air must reach for saturation to occur. At a temperature of 83°

F and relative humidity of 60%, the dew point necessary for water to collect on a surface is 68 ^{o} F. Surface temperatures measured in most areas with active, chilled air ventilation were equal to or below the dew point on August 22, 2003. Any surface inside the OHES that had a temperature at or below 68 ^{o} F would generate condensation. The surface temperatures for a variety of building components were measured in a number of areas throughout the OHES (Table 1). The surface temperature of pipe insulation, pipe hanger, univent cabinets a gypsum wallboard (GW) was significantly below the outdoor dew point. The temperatures of building components caused condensation generation, which moistened these materials. Please note that gymnasium ductwork, which was not operating and had a temperature above the dew point, was not generating condensation (Picture 5).

Pipe insulation that is moistened for an extended period of time can result in several problems. The exterior wrap is made of a paper material that, if not dried, can serve a medium for mold growth. In addition, wetting of insulation can degrade its performance, resulting in increased energy costs. Lastly, condensation occurs if spaces in the insulation exist or the R rating of the insulation is not sufficient. Spaces between insulation sections can allow moist air to be exposed to the metal of the chilled water pipes, which results in condensation. The R rating is a mathematical representation of the ability of insulation to prevent temperature transfer. If an air conditioning system has chilled water pipes with an insufficient R rating, temperature could be transferred to the surface paper, thus creating condensation. Once water wets insulation, a temperature bridge is created, which results in further wetting of insulation and enhancing mold growth.

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If these materials are not dried within this time frame, mold growth may occur. Once colonized by microbes, the cleaning of water-damaged porous materials cannot be adequately cleaned to remove mold growth.

Conclusions/Recommendations

BEHA staff made a number of immediate recommendations to decrease relative humidity on the day of assessment. These recommendations included the following steps.

1. Reactivate dehumidifiers. Have dehumidifiers operate to empty water into the plumbing drainage system or to direct water outdoors.
2. Reactivate the exhaust ventilation system to remove water vapor from the building.
3. Limit the amount for fresh air introduced into the building by univent operation.
4. Raise the temperature within the building to decrease condensation on building components above the dew point. Prior to increasing temperature, contact the manufacturer of univents to ascertain the appropriate procedure to raise the temperature to prevent cracking of coils that had temperatures below freezing.

Once condensation is was under control, the following recommendations are made:

1. Deactivate the air-conditioning system until control of condensation from this HVAC system is achieved. Continue to consult with a ventilation engineer concerning appropriate measures to control condensation generated by the air-conditioning system.
2. Ascertain whether moistened building components had become mold colonized. If mold colonized, remediate mold contaminated building materials in a manner consistent with *Mold*

Remediation in Schools and Commercial Buildings published by the US Environmental Protection Agency (US EPA) (US EPA, 2001). Copies of this document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html

3. Consider consulting a building engineer to determine the extent of the effect of water damage to chilled water pipe and univent insulation. Remediate as needed.
4. Ensure that univent drain pans in univents to properly drain condensation.

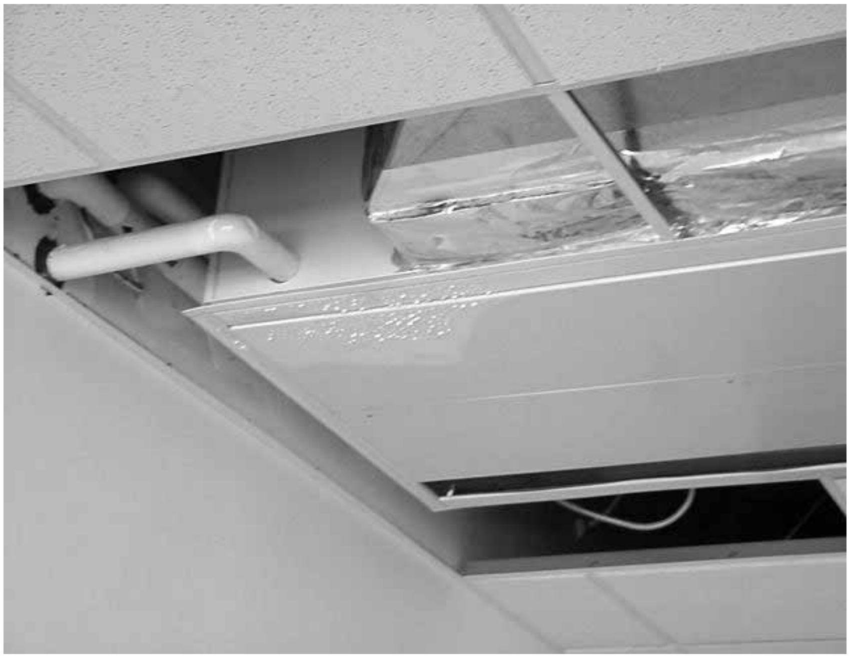
References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

The Weather Underground. 2003. Weather History for New Bedford, Massachusetts, August 22, 2003.
http://www.wunderground.com/history/airport/KEWB/2003/8/22/DailyHistory.html

US EPA. 2001. *Mold Remediation in Schools and Commercial Buildings*. Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. March 2001.

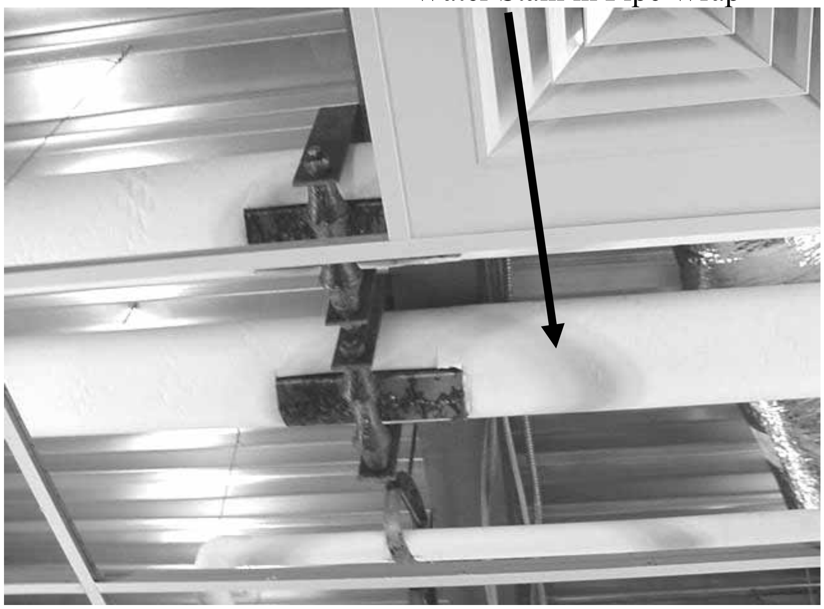
Picture 1



Condensation Droplets Were Noted On Unit Ventilator (Univent) Cabinets

Picture 2

Water Stain in Pipe Wrap



Chilled Water Pipe Hangers (Note Rust And Water Staining)

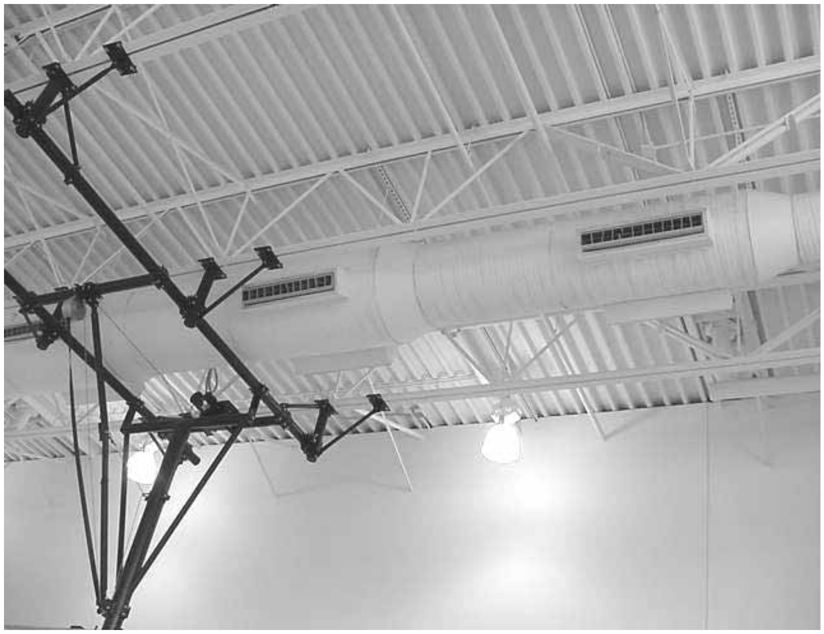
Picture 3

Minimal Drainage of Condensation from a Univent Drip Pan Drain

Picture 4

No Drainage of Condensation from a Univent Drip Pan Drain

Picture 5



Gymnasium Duct Free of Condensation

TABLE 1

Indoor Air and Temperature Test Results*
Mattapoisett, Old Hammondtown Elementary School
August 22, 2003

Location	Temp (°F)	Relative Humidity (%)	Surface Temp gypsum wall board (°F)	Surface Temp insulated pipes along ceiling (°F)	Surface Temp pipe hangers (°F)	Surface Temp univent cabinet (classrooms), gymnasium (ventilation duct) (°F)	Surface Temp univent coils (°F)	Comments
B109	68	67	48	44	45	44	32	
B110	69	69	52	57	58	50	37	
B113	68	72	54	-	-	48	33	
B114	71	81	60	-	-	68	62	univent deactivated
B115	72	80	59	-	-	65	64	
B116	71	70	50	-	-	41	38	
B127	72	70	55	-	-	56	-	univent coil inaccessible
B129	71	70	51	-	-	43	37	
C102	73	75	63	62	66	62	-	
C110	72	74	52	54	55	37	31	
Hall Outside A100	79	69	-	-	58	-	-	
Gymnasium	81	77	-	-	-	78		Not air conditioned, No condensation noted
Hallway outside A157	79	69	-	60	54	51	-	Water beads visible on exterior of cabinet
A158	76	65	-	57	50	52	-	
Library	74	56	48	-	-	45	-	
B104	71	68	-	42	46	49	-	
B106	71	69	-	48	46	33	-	
B107	70	68	52	53	57	48	37	
B108	70	66	45	42	45	43	32	

Note: Dew point on this date was: 68° F